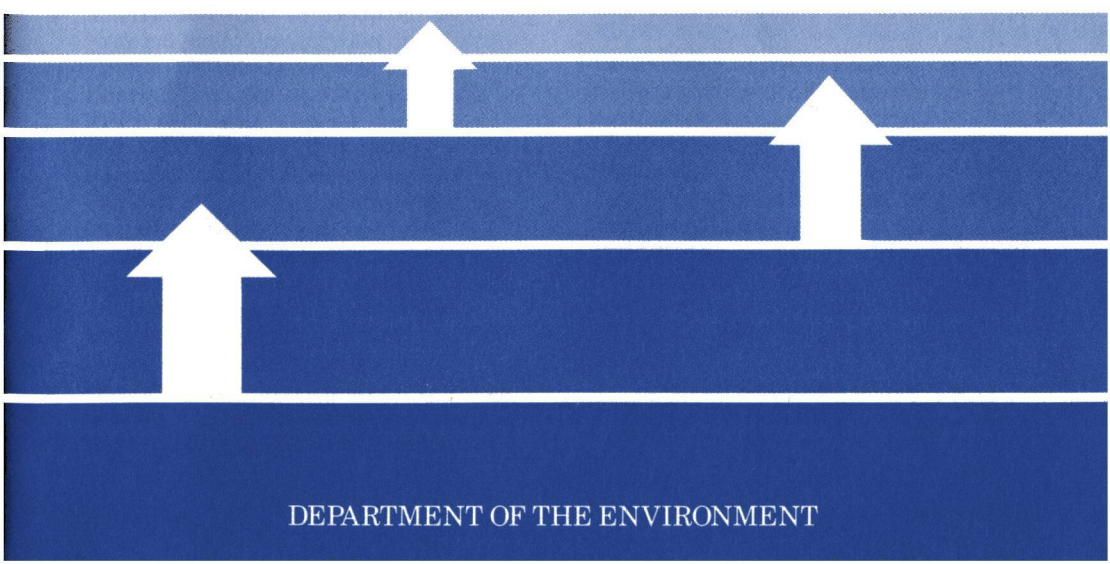
# THE HOUSEHOLDERS' GUIDE TO

# RADON

## THIRD EDITION



DEPARTMENT OF THE ENVIRONMENT

# PART 1

# SOME FACTS ABOUT RADON

## INTRODUCTION

This is the third edition of the Householders' Guide, which was originally published in June 1988. It is a follow-up to the leaflet "Radon in Houses" which is also issued by the Department of the Environment. It is intended for people who live in areas with high levels of radon, particularly for householders whose homes have already been tested and found to have an appreciable level of radon. It explains what radon is, how it gets into houses and what the effects on health may be. It also outlines some of the ways of reducing the level of radon and gives guidance both on how to get the work done and on likely costs.

The Guide is in three parts. Part 1 answers some questions about radon itself, including how it can be measured. Part 2 tells you what you can do if you have a high level of radon in your home. Part 3 answers more of the questions that are most often asked.

**Radon measurements**

If you live in an area which might be affected by radon and want to have your home tested, write to Radon Survey, National Radiological Protection Board, Chilton, Didcot, Oxon OX11 ORQ. Depending mainly on where you live, NRPB will advise whether your home should be measured. If the advice is that a measurement should be made, it will be FREE. If not, you may still have it done, but you will have to pay.

If measurements are to be made, NRPB will send you two small detectors: one for the living room, one for the bedroom. The detectors contain special plastic to measure radon and are harmless. After three months they should be returned for processing. NRPB will write to tell you the radon level in your home. In some cases NRPB may suggest measurements for a further three months to get a more accurate estimate of the average radon level in your home. Radon measurements taken over a period shorter than three months can be seriously misleading.

## WHERE TO GO FOR MORE HELP AND ADVICE

You should initially approach your local council (the Environmental Health Officer or the Building Control Officer) for advice.

Some government departments, trade associations, contractors' federations and professional bodies will also be able to advise, as described later in this Guide. Their addresses are listed on page 16.

Detailed technical advice on reducing the level of radon can be obtained by writing to the Building Research Establishment or calling the BRE "radon hotline" by telephone. The BRE's address and the "hotline" number are also given on page 16.

## OTHER PUBLICATIONS

The Building Research Establishment are providing more detailed information in the form of technical guidance notes. These are available as priced publications from BRE.

Advice on new dwellings, which could also be of assistance to someone extending an existing dwelling, is given in "Radon: guidance on protective measures for new dwellings" (Report Number BR211) available as a priced publication from the BRE.

General publications on radon are available from the NRPB.

## WHAT IS RADON?

Radon is a natural radioactive gas which has no taste, smell or colour. Special equipment is needed to detect it.

The level of radioactivity in the air due to the presence of radon is measured in units of 'becquerel per cubic metre' (Bq/m3). The average level in UK houses is 20 Bq/m3.

## WHERE DOES RADON COME FROM?

Radon comes from the radioactive decay of radium, which in turn comes from the radioactive decay of uranium. Uranium acts as a permanent source of radon and is found in small quantities in all soils and rocks, although the amount varies from place to place. However, radon levels vary not only between different parts of the country but even between neighbouring buildings.

Radon in the soil and rocks mixes with air and rises to the surface where it is quickly diluted in the atmosphere. Concentrations in the open air are very low. Radon that enters enclosed spaces, such as houses, can reach high concentrations in some circumstances.

## HOW CAN RADON AFFECT ME?

When radon decays, it forms minute particles of other substances which are also radioactive. These are called radon decay products or radon daughters. If formed in air, these particles may be inhaled and some will be deposited in the lungs. The radiation emitted by them as they decay can give a high dose to lung tissues and damage them.

Exposure to radon and its decay products increases the risk of developing lung cancer. Lung cancer caused by radon is indistinguishable from that caused by other factors, including cigarette smoking. The average lung cancer risk in the whole of the UK is about six in one hundred and is mainly attributable to cigarette smoking. The table below gives comparative figures for some other risks of everyday life.

**Lifetime risks of death from common causes**

| | |
|---|---|
| Fire and Flames: | 1 in one thousand |
| Pedestrian accidents: | 3 in one thousand |
| Average radon in houses: (20 Bq/m3) | 3 in one thousand |
| Indoor accidents: | 8 in one thousand |
| Lung cancer: | 60 in one thousand |
| All cancers: | 250 in one thousand |

Current estimates suggest that where people are exposed to radon, smokers are much more likely to be at risk of lung cancer than non-smokers. For lifetime exposure to radon at the Action Level (200 Bq/m3)*, it is estimated that smokers have a risk of lung cancer of the order of ten in one hundred, whereas the risk for non-smokers is estimated to be one in one hundred. Further estimated examples are shown in the table overleaf, which compares the risks of contracting lung cancer from radon exposure between smokers (smoking 15 cigarettes a day) and non-smokers.

* See page 4 in the section 'WHAT SHOULD I DO IF MY HOME HAS A HIGH LEVEL OF RADON?'

**Lifetime risk of lung cancer potentially induced by radon**
**Estimated lifetime risk**

| Radon Concentration Bq/m$^3$ | Smokers | Non-smokers | Total population |
|---|---|---|---|
| 20 | 10 in one thousand | 1 in one thousand | 3 in one thousand |
| 100 | 50 in one thousand | 5 in one thousand | 15 in one thousand |
| 200 | 100 in one thousand | 10 in one thousand | 30 in one thousand |
| 400 | 200 in one thousand | 20 in one thousand | 60 in one thousand |

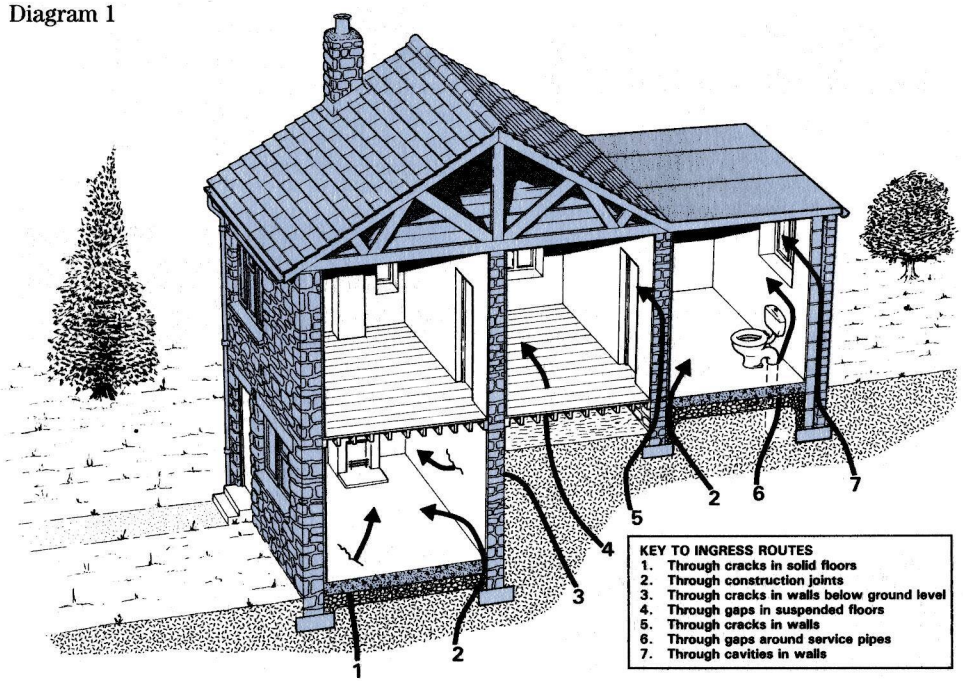
## HOW DOES RADON GET INTO MY HOME?

Air from the soil containing radon may enter through any opening between the house and the underlying soil or rock. These openings may include very small cracks which can be difficult to find. The air pressure indoors is often slightly lower than that in the soil because of the effect of wind and temperature, so air is drawn from the ground into the house.

Diagram 1 shows how radon can enter a house.

Indoor radon levels that are high enough to cause concern are usually due to radon from the soil. Although building materials such as brick and stone (including granite) also contain uranium and produce radon, the amount they produce is insignificant.

Diagram 1



## HOW DO I KNOW IF MY HOME HAS A HIGH RADON LEVEL?

A survey by the National Radiological Protection Board, the Government's advisers on matters of radiation protection, has shown that the majority of homes in the UK do not have significant radon levels. In certain areas, however, high levels do occur, and many people in these areas have had their homes monitored by the NRPB; others are currently having radon measurements. These surveys are being carried out for the Government to identify homes with the highest levels.

Wherever you live, if you are worried that your house may have a high radon level, you should write to the NRPB Radon Survey at the address on page 16.

## HOW ARE THE MEASUREMENTS MADE?

The NRPB will send you two small detectors, one for the living room and one for an occupied bedroom. The detectors contain special plastic to measure radon and are harmless. They are sent back to the NRPB after three months for processing.

This may show that there is a high radon level, and action to reduce it will be advised, or it may show that there is a low level and no further action is necessary. In some cases, the NRPB may suggest further free measurements to make a more accurate estimate of the radon level in your home.

## WHO HAS ACCESS TO MY RADON RESULTS?

The results of measurements by the NRPB and the Building Research Establishment (BRE) are available only to the occupier of the house and will not be disclosed to anyone else.

When the householders are known to be tenants of private or public sector landlords, NRPB supplies the householders with two copies of their results, to allow them to pass one on to their landlords.

Tenants will need to consider whether their landlord's responsibilities cover the sort of measures referred to in this Guide. In the great majority of tenancies, landlords are responsible for keeping the exterior and interior of the structure in a reasonable state of repair. Landlords may have further responsibilities depending on the precise terms of the tenancy agreement, which also identifies tenants' responsibilities.

It is therefore advisable to discuss the matter with your landlord. You may also need to take legal advice about your particular rights and obligations.

If you are an owner-occupier there is no legal obligation on you to disclose the results to anyone, but if you are selling or buying a property in an affected area, you should take legal advice about any contractual matters.

## WHAT SHOULD I DO IF MY HOME HAS A HIGH LEVEL OF RADON?

The risk of developing lung cancer increases as the level of radon and the duration of exposure increase. Radon levels indoors vary considerably during the day, from day to day and from season to season.

It is the average level which is important: short exposures to high levels will not be important for health if the average exposure over a long time is low.

Because of this, you should take no action to reduce radon levels until the average has been measured over a

fairly long period normally three months.

There is a recommended Action Level for radon in existing homes, above which you should take action to reduce it. The Action Level is set at an average radon concentration of 200 $Bq/m^3$ over a year.

If the estimated average radon level in your home is above the Action Level you should take action as soon as possible

# PART 2

# WHAT TO DO ABOUT RADON

## REDUCING THE LEVEL OF RADON INDOORS

It is better to prevent the entry of radon into a house than to try to remove it once it is present. In practice this means preventing the radon-laden air from the ground under the house entering through any openings in the floors and walls – as shown in diagram 1.

Owing to differences in temperature and pressure indoors and outdoors the air in a house is constantly changed. As air leaves through windows, chimneys or ventilators it is replaced. In part it is replaced by fresh air drawn through doors and windows, but where air is drawn in through the floor of the house radon may enter with it.

There are five main ways in which you can reduce the amount of radon entering the house, but they are not all suitable for all types of house. You should read the Guide carefully and choose a technique which is most likely to be effective in your circumstances:

1) you can reduce the pressure below the floor by using a radon sump (in the case of solid floors). This is generally the most effective method and in many cases will reduce the radon level to less than one tenth of the existing level, but it is generally only possible for solid floors.

2) you can seal the floor to prevent the radon getting through (not recommended in the case of suspended timber floors). This is only effective at moderate radon levels and generally it is difficult to reduce the radon level to much less than half by this means.

3) you can increase the flow of air under the floor (in the case of suspended floors). This is generally fairly effective, particularly when fan assisted.

4) you can pressurise the house with a fan drawing air from the loft space. This method is again generally only effective at moderate radon levels and it is difficult to reduce radon levels to much less than one third of the initial level by this means.

5) you can in some cases change the way the house is ventilated, to avoid, as far as possible, drawing air and radon through the floor; but as this generally depends on the occupants' behaviour it is not a reliable remedy for the house.

**Opportunities to reduce radon during other building work**

There are also good opportunities to reduce radon levels during other building work, particularly when extending your house or when you have the ground floor replaced or repaired. The following measures for reducing the level of radon

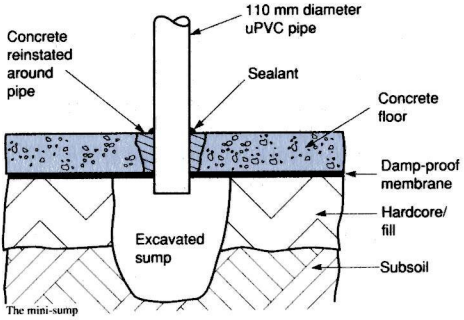
indoors should be considered for inclusion as part of this building work. BRE could give detailed advice.

## REDUCING PRESSURE BENEATH A SOLID FLOOR (THE RADON SUMP)

Using a fan to suck air containing radon from beneath a solid floor can be very effective and is generally the most suitable method where large reductions in indoor radon levels are required.

The air below a solid floor, which exists in voids in the hardcore and other fill material below the floor, will often be contained by relatively uninterrupted foundation walls.

Diagram 2



The mini-sump

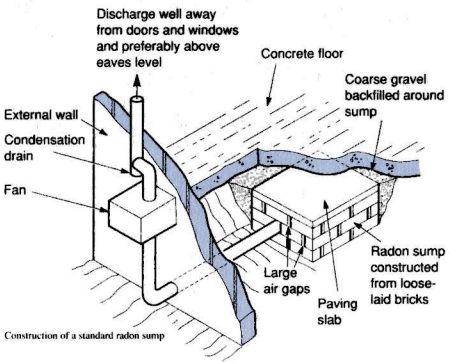
### General principles on the construction of a radon sump.

The general approach is to dig out a small sump, about 400mm across, under or alongside the house. The radon-laden air can then be drawn out through a pipe by a small fan.

Where a floor slab is sound, an internal sump can be made by cutting a hole through the floor and digging out a small amount of underfloor material. The pipe can be run up through the house and out through the roof of the building (see diagram 2).

Alternatively, a sump may be constructed as shown in diagram 3, the pipe being run either under the floor to outside as shown, or up through the house as described above.

Diagram 3



Construction of a standard radon sump

The practical details of installing sumps depend on the layout of the house, the type of solid floor, the nature of the material under the floor, and the ground level. One sump per house will probably be sufficient.

If, however:

the floor area is large;

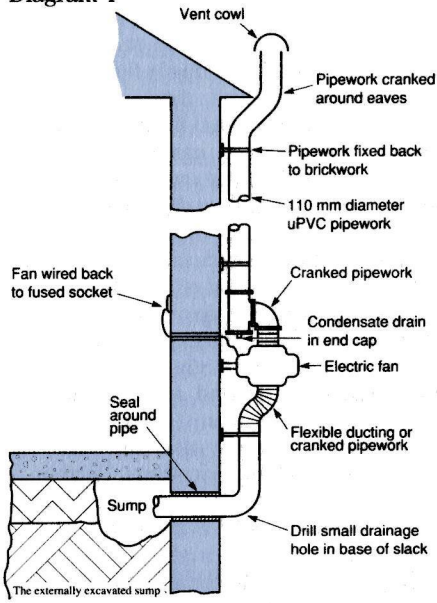
or the soil or fill is not very permeable;

or there are dividing walls,

then more than one sump may be required.

Provision should be made to allow any condensation that forms in the pipe to drain away (see diagram 3) and to prevent condensation running on to the fan. This is normally only necessary where the pipework runs up the outside of the building.

Diagram 4

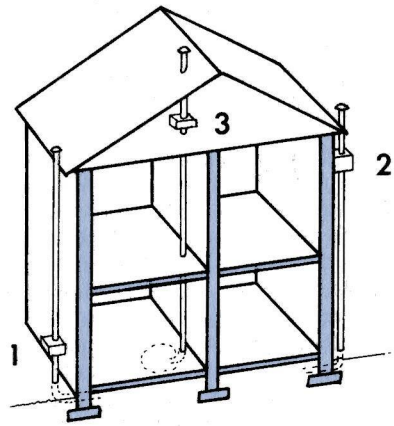

Vent cowl
Pipework cranked around eaves
Pipework fixed back to brickwork
110 mm diameter uPVC pipework
Fan wired back to fused socket
Cranked pipework
Condensate drain in end cap
Electric fan
Seal around pipe
Flexible ducting or cranked pipework
Sump
Drill small drainage hole in base of slack
The externally excavated sump

In some cases sumps can be constructed externally by cutting a hole through an external wall below floor level (see diagram 4). These can avoid disruption inside the building and the costs can be considerably lower.

All types of sump systems usually give good results and can in the right circumstances remove 90 per cent or more of the radon. Further details can be obtained from "Radon Sumps: A BRE guide to radon remedial measures in existing dwellings."

**Extract fans and outlets**

Diagram 5




Positioning of extract fans and outlets
Fans should preferably be located at the rear of houses in an unobtrusive position

1. Noise may be more noticeable in ground floor rooms if fan is located at low level
2. Fans sited at high level externally should be located away from bedroom windows
3. Ideally, fans should not be located directly above bedrooms.

With any fan system it is important to locate the air outlet away from the windows and doors, preferably taking it above the roof eaves level to prevent any radon-laden air from re-entering the building.

Fans can be fitted unobtrusively outside the house, perhaps covered with a box. Avoid siting the fan near a bedroom as it will have to run continuously and you may find the slight noise troublesome at night (see diagram 5). Fans can also, with care be installed in the loft, but the outlet should still always discharge into the outside air, never into the roof space. To avoid troublesome noise avoid siting fans in the loft near to bedroom ceilings.

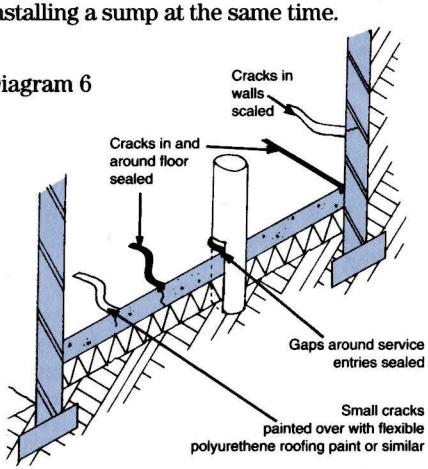
## SEALING THE FLOOR

Sealing is not recommended in the case of suspended timber floors because of the danger of dry rot and other forms of timber decay, due to increased moisture content in the timber, which may arise from sealing. This is particularly the case for older houses which only have bare earth below the floor.

Suspended timber floors are dealt with in a later section.

Satisfactory results have been achieved by sealing floors, but this may not achieve the necessary reduction in radon levels. It is difficult to find and seal every point of entry, so sealing is often combined with other measures. When you are sealing the floor, you could consider the possibility of installing a sump at the same time.

Diagram 6


Cracks in walls scaled
Cracks in and around floor sealed
Gaps around service entries sealed
Small cracks painted over with flexible polyurethene roofing paint or similar

**Painting over or sealing cracks and service entries in solid floors, and cracks in walls against the ground. It is important to achieve an airtight seal. Pay particular attention to cracks around the edges of rooms.**

The treatment of solid floors will depend on their condition and type. In most modern houses and in those older properties in which floors have been replaced in recent years, solid concrete floors should be dry, free from visible cracks and settlement and in generally good condition. Where this is the case you may need to do no more than seal the edges between walls and floors and seal around service entries (gas and water pipes etc). Small cracks can be sealed with a roofing paint (see diagram 6).

Larger cracks in an otherwise generally sound floor should be thoroughly cleaned and repaired with a suitable flexible filler. Avoid hard-setting filling compounds – the crack may well have been caused by slight seasonal movement in the ground, and the filler will need to adjust to any future movement. Some paints and fillers may react with vinyl floor coverings. Further guidance can be obtained from the BRE Report "Sealants: A BRE guide to radon remedial measures in existing dwellings."

In extreme cases where the main concrete base of the floor is badly cracked and in poor overall condition it may need to be replaced. Where this proves to be necessary, it would also make sense to construct a radon sump and pipe to an external wall. This need not be connected to a fan at this stage, but if your radon levels are not reduced sufficiently by the methods you have tried, it is an easy matter to add the fan and outlet pipe.

### Concrete raft floors

This is a relatively uncommon form of floor and foundation combined and you may need expert advice to identify a floor of this type. It consists of a reinforced concrete slab which carries the entire structure. The slab is thickened out, with extra reinforcement, below load-bearing walls. Because of the nature of the construction there should be few gaps between the underside of the slab and the inside of the house. Sealing should be necessary only around service pipes or other openings or construction joints.

**Suspended concrete**

For some years, builders have been using a variety of suspended floors. The most common form has precast concrete T beams supporting concrete blocks – commonly known as beam and block floors. These structural floors are either covered with a cement/sand screed or chipboard flooring. In either case a layer of thermal insulation and/or a damp-proof membrane may be incorporated between the structural floor and the screed or chipboard. Either of the latter may be covered with carpets, PVC sheets or tiles or other floorings.

A screed in good condition can be treated in the same way as a solid floor. Where there is chipboard, the joints, and particularly the perimeter edges, should be sealed.

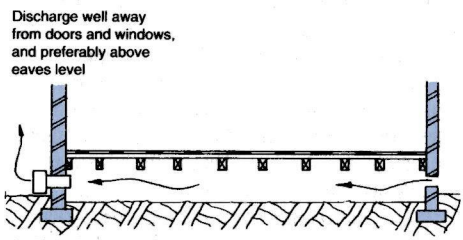
## VENTILATING SUSPENDED FLOORS

This approach uses ventilation to dilute and remove radon from the underfloor space. Ventilation may be either natural ventilation using airbricks or, if this proves inadequate, fans may be used either blowing or extracting. There is some evidence that blowing may be more effective but this may give rise to draughts. Ventilation of the underfloor space may lead to excessive heat loss. Research in this area is continuing. Further information can be obtained from BRE.

The space below a timber floor needs in any case to be well ventilated. Stale, moist air below floors encourages various forms of timber decay. To avoid this, foundation walls on both sides of a house should have air bricks built into them. Air bricks are bricks perforated with holes or slots which allow air to pass from one side of the wall to the other. To block these air bricks up, therefore, in order to create an air-tight space or to reduce draughts, may cause serious damage to the floor and increase indoor radon levels.

Increasing the number of air bricks to provide better natural ventilation beneath the floor may achieve an adequate reduction for moderate radon levels. Where more substantial reductions in radon levels are required a fan may be fitted to provide additional ventilation of the underfloor space (see diagram 7). If there is an adequate number of airbricks to ventilate the floor, then obvious large holes and cracks can be sealed, but covering the floor with polyethylene or other plastic sheets and edge sealing is not now recommended for timber floors.

Diagram 7




**Enhancing ventilation under a suspended floor with an increased number of air bricks. A fan may also be fitted (see text).**

## PRESSURISATION SYSTEMS

Fans are available which blow fresh air (or air from a loft space) into the house and it may be claimed that these can increase the air pressure in the house sufficiently to exclude radon. Although this might be achieved in a house that was particularly airtight, the effect in many houses will mainly be to increase the ventilation rate (and hence dilution), of

radon. The fans tend to cause localised cold draughts and slightly increase heating costs but many householders find them acceptable and effective. They often reduce condensation problems at the same time. House pressurisation fans are only likely to be effective for radon levels which are up to 2 or 3 times the Action Level.

## MODIFYING HOUSE VENTILATION

Houses need to be ventilated to get rid of excess water vapour, which can lead to condensation and mould growth, and normal household pollutants such as cooking smells and cigarette smoke.

Ventilation will also dilute any radon entering the house but it is not a permanent or reliable solution. Increasing ventilation alone can only achieve a modest reduction in radon levels but the way the house is ventilated can have a significant effect on the rate at which air and radon are drawn through the floor.

Ventilation practices which help reduce the amount of radon entering the house are such things as;

- using downstairs windows to ventilate the house while keeping upstairs windows closed;
- avoiding the use of extract fans in kitchens, bathrooms and WCs;
- installing trickle ventilators into downstairs window frames; capping off and sealing of unused chimneys; avoiding the use of open fires and solid-fuel-effects open fires.

It should be noted that opening upstairs windows can *increase* indoor radon levels.

Unfortunately, using windows in a particular way and avoiding use of extract fans can be difficult to sustain indefinitely and could lead to problems with cold draughts, lingering odours and perhaps even condensation in some cases. Thus these two items are not strongly recommended to reduce radon levels, but they can help.

Installing trickle vents, capping chimneys and avoiding open fires are recommended actions, but they are still likely to have only a modest effect on indoor radon levels. They should only be contemplated on their own in houses which have radon levels close to the Action Level.

## CHIMNEYS

Any unused chimneys should preferably be blocked up since they tend to draw air out of the room. If you decide to block them up permanently, it is important to prevent condensation from building up inside the chimney. Cap the chimney stack with a chimney-pot hood and provide a small ventilation opening of about 50 x 20 mm in the blocked-up fireplace. BRE "Defect Action Sheet 93" deals with this in greater detail.

If you have a gas, coal or oil fired appliance that discharges into a chimney, make sure that there is an adequate supply of fresh air into the room from outside the house. Open coal or wood fires in particular can draw large volumes of air out of a room, even when they are provided with an underfloor supply of air directly to the fire. If you have alternative forms of heating available, and can do without an open fire, you should consider blocking up the chimney as described above.

Some central heating boilers and gas fires will have 'balanced' flues. These take all the air they need for combustion and get rid of all the exhaust gases through the same metal terminal in the wall. As they draw no air from the house, they are

ideal for radon Affected Areas. If you are planning to install or renew a central heating boiler you should ask your supplier to recommend a balanced-flue room-sealed type without an underfloor draught. This may also mean that you will have to change the position of your boiler to a suitable external wall, so you may want to get professional advice.

## COSTS

It is only possible to give an approximate guide to costs for any particular house. If you are doing the work yourself, it should cost very little. Most of the materials are cheap – the most expensive, if you decide to fit one, will be an extract fan and pipework, starting at about £200 for a simple DIY system. You will also need to budget for the cost of running the fan, which may be about £45 a year, and you might expect to have to replace the fan after a few years at a cost of £60 to £100.

The bulk of the costs, if you are going to have the work done by a builder, will be the cost of labour. Sealing a concrete floor in good condition is relatively easy and should not take more than a couple of hours once the furniture has been moved. Repairing or replacing a defective concrete floor could take several days.

Again, remember that it may be cheaper to have several things done at once. The builder will have a number of fixed overheads that he will charge per job, such as the costs of hiring plant and equipment. Having to make several visits to a house will inevitably cost more than only visiting once.

Experience with houses in the BRE's programme of field trials shows that work carried out by a builder is likely to cost between £300 and £1500. However, costs are largely dependent on the size of the building firm employed and the nature of the works being undertaken. Small builders with lower overheads may charge less.

Typical costs for works carried out in a house with 3-4 rooms on the ground floor:

Sump system £350-1500

Replace floor with new concrete floors £1000 + per floor

Seal major gaps and cracks £30-50

Increase underfloor ventilation with extra vents £20-50 per air vent (depends on thickness of wall)

Fan to underfloor void £200

Positive Pressurisation £400-700

If the costs are likely to be at the upper end of this range, you may think it worthwhile to employ a professional adviser such as a chartered building surveyor or an architect. Their fees are not likely to be less than £200, but they will be able to advise on choosing a builder, negotiate prices and keep a check on the quality of the work carried out.

## GETTING APPROVAL TO CARRY OUT THE WORK

If you own your home but have a mortgage, you may need to get the lender's permission before making any major changes to the house, but not for small jobs. If you are not sure of the terms of your mortgage agreement, check with your lender before starting work.

If you are a tenant, you will need to discuss any work to reduce radon levels with your landlord before you start. You may be allowed to do some of the jobs yourself, but other work may need to be carried out by the landlord, especially if it affects the structure of the building.

You will not usually need planning permission or building regulations approval for small radon jobs, unless you

are making more substantial changes at the same time. Check with the Building Control Officer at your local council.

If your house is a listed building or in a designated area of outstanding natural beauty, a national park or a conservation area, you may need to get permission for alterations which affect the external appearance of your house. Check with the Planning Department of your local council.

## PAYING FOR THE WORK

Building societies have agreed in principle, subject to the applicant's status, to provide the necessary loan finance for the cost of radon work. If you cannot afford to pay for the work yourself, your local authority may be able to give you a house renovation grant to cover all or part of the cost. These grants, which are discretionary, will be subject to a test of your resources to determine the amount of money you may have to contribute. Booklets on"House Renovation Grants" and "Paying for Repairs and Improvements to your Home", are available from your local authority or Citizens' Advice Bureau. Contact your local council or Citizens Advice Bureau for further information.

If you live in Scotland you may be eligible for a discretionary repairs grant from your local authority and you should ask them for further information.

## CHOOSING A BUILDER

This whole subject is relatively new to the UK. Expertise is gradually building up, particularly in high radon areas. It is best to employ a builder with a good general reputation, and preferably one who has some experience of radon preventive work, either in the construction of new dwellings, or in the treatment of existing houses.

Training courses for builders have been given by the Building Research Establishment and the National Radiological Protection Board and by the Building Employers Confederation and the Federation of Master Builders. The local officers of the BEC and the FMB may be able to supply the names of builders who have attended suitable courses in radon remediation and who have suitable experience.

To be effective, radon treatment should be carried out to a high standard of workmanship using good quality materials. This is true whether you are employing a builder, or expecting to do the work yourself.

### Professional advice

Employing a builder can be a daunting prospect for some people. If you are worried or unsure how to go about it, you may want to get professional advice from an architect or building surveyor. They will be able to recommend builders, advise on contractual matters and builders' quotations, control the quality of the work and certify that the final sum you pay the builder will have been for the correct amount and for work properly carried out.

### 'Lump sum' contracts

However, many people employ builders directly to do routine household repairs and improvements, and radon work need be no different. It is best if you can decide in advance what work you want to have done and write it down. Then you can ask several builders to give you competitive quotations for the work (three is the minimum number you should get).

Ask them to quote on a 'lump sum' basis, which means that they will include in the price everything they think is

necessary to complete the job as you have described it. Of course, if anything unforeseen occurs, like discovering dry rot in the floor joists, you will need to agree a variation in the price. Normally, though, you can be reasonably sure of the final cost of the work and can budget accordingly.

**Time and materials or 'dayworks' contracts**

It may be that you cannot at that stage say how extensive work will need to be. For example, unless you can clear all the furniture and take up the carpets beforehand you may not know how much work needs to be done to seal the floor.

For this reason, you may prefer to ask the builders to quote an hourly rate for their work and a rate for the supply and fixing of materials (eg so many pounds per hour for moving furniture, so many pounds per metre for sealing edges of floor or sealing, around service pipes etc, and so on). You may also want to ask them to give an estimate of the overall cost.

Remember that an estimate is not the same as a quotation. A quotation is a firm commitment to do a job at a certain price or rate. An estimate is no more than an approximate guide to the eventual total cost.

Once you have made your decision about which builder to use – based on reputation and quoted rates – you can then proceed step by step. Do a room at a time. Clear furniture and take up the carpets. Then you and the builder can look at the work that needs to be done in that room and agree a firm price based on the amount of work and the builder's quoted rates.

On the last page of this guide you will find a list of trade associations, contractors' federations and professional bodies who will be able to give a list of members in your area, some of whom may be experienced in radon work. Members of these bodies are committed to carrying out work to a high standard, with the safeguard of an arbitration and complaints procedure. Work may also be covered by an insurance-backed guarantee scheme. Check this before you sign any contract. Remember that oral agreements can form a contract also, but it is best to get everything in writing. You can send for a free copy of "Home Improvements", published by the Government's Office of Fair Trading at Room 306, Field House, 15-25 Bream's Buildings, London EC4 1PR, or enquire at your local authority Trading Standards Department or Citizens Advice Bureau.

## RETESTING FOR RADON

When you have taken action to reduce the radon level in your home, it is recommended that you retest to show how successful that action has been. The most suitable technique is to use two plastic detectors over a minimum of three months. These detectors, and guidance on their use, can be obtained from the NRPB Radon Survey.

# PART 3

## MORE QUESTIONS ANSWERED

**Q. Is only the South-west of England affected by radon?**

A. No. Radon is present in all parts of the UK, but in most areas the levels are quite low. Some of the highest levels have been found in the South-west, but other areas with levels well above the average have been found, as in parts of Northamptonshire, the Pennines and the Highlands of Scotland. Even in South-west England, most houses are below the Action Level.

**Q. Do radon levels vary with time?**

A. Yes. Radon levels in houses vary during the day, from one day to the next, and from winter to summer, mainly because of temperature differences between indoors and outdoors. They are generally higher at night and during the winter. This is the reason why radon measurements have to be made over several months.

**Q. Why do radon measurements take so long?**

A. Radon levels in houses vary so much that it is not possible to predict with any certainty the long-term values from short-term measurements.

**Q. Is there any risk from staying in a holiday home with high radon levels?**

A. The risk from radon is calculated for a lifetime spent in the same house; the risk from holiday periods will be very small.

**Q. I am going to move to an area where high radon levels occur. How do I discover if my new house has a high level?**

A. Even in South-west England, most houses have low levels of radon, and high levels can generally be remedied at a fairly moderate cost. Concern about radon should therefore not influence your choice of house. Once you have moved, you can obtain a measurement from NRPB funded by government departments, and if the level is high, you will receive advice on how to reduce it. However, you may wish to ask your surveyor to enquire whether measurements and/or remedial works have been taken.

**Q. If I am thinking of selling my house, should I bother to have it measured for radon?**

A. Yes. If your house is found to be below the Action Level, or, if it is above and you have remedial work done, both of these could be to your advantage in persuading a would-be buyer to choose your house.

**Q. Could I be exposed to radon at work as well?**

A. Yes. Radon can affect buildings used for work in the same way as houses. In particular, high radon levels have been found in shops, offices and public buildings in some areas.

**Q. Who is responsible for controlling radon at work?**

A. Your employer. Radon in the workplace is subject to legal controls. If you have concerns, they should be taken up with your employer. Further information may be obtained from the local Health and Safety Executive Area Office or the Health and Safety Executive Information Centre at the address shown on p.16.

**Q. I understand that smoke detectors contain radioactivity. Does this affect radon measurements?**

A. No. Smoke detectors contain a small amount of radioactive material, which does not emit radon and will not affect measurements in your house.

**Q. Does a high radon level necessarily mean spending a lot of money on the house?**

A. No, not necessarily. The cost of curing radon problems depends on the construction of the house more than the radon level.

**Q. Are older houses more prone to radon or more expensive on average to cure than newer houses?**

A. No, but in undertaking any alteration to an old house there is more chance of other deficiencies being discovered than with a newer property.

**Q. Are children exposed to radon at school?**

A. Radon exposures at school are generally lower than at home. Some local authorities in the most affected areas are making measurements in schools and taking action where necessary to reduce radon levels. If you have concerns, they should be taken up with the school or with the local education authority.

**Q. Are high radon levels found only in granite areas?**

A. No. The highest levels have been found in some houses on or near granite in South-west England, but not all granites give high levels. Some other rocks also cause high radon levels.

**Q. Do granite walls cause high radon levels?**

A. The main source of radon is the ground below the house. Granite walls and fireplaces do not emit much radon.

**Q. Is anything being done to prevent radon problems in new houses?**

A. Yes. Requirements for radon protection in new houses are being specified for the most affected areas.

**Q. Can geiger-counters detect radon?**

A. No. Geiger-counters are unable to detect radiation from radon and its decay products at the levels found in houses.

## SOME USEFUL ADDRESSES

Department of the Environment
(i) General Enquiries to Room A518
Romney House
43 Marsham Street
London SW1P 3PY

(ii) Queries on New Construction to
Construction Directorate
Room P1/063
2 Marsham Street
London SW1P 3PY

Housing Division
The Scottish Office Environment
Department
Room 431
St Andrews House
Edinburgh EH1 3DG

Radon Enquiries
Housing Division
Welsh Office
Cathays Park
Cardiff CF1 3NG

Information on radon in the workplace may be obtained from the Health and Safety Executive Information Centre at:-
Broad Lane
Sheffield S3 7HQ

Radon Survey
National Radiological Protection Board
Chilton
Didcot
Oxfordshire OX11 ORQ

Building Research Establishment
Garston
Watford
WD2 7JR

BRE Radon Hotline:
Tel: 0923 664707

Royal Institute of British Architects
66 Portland Place
London W1N 4AD

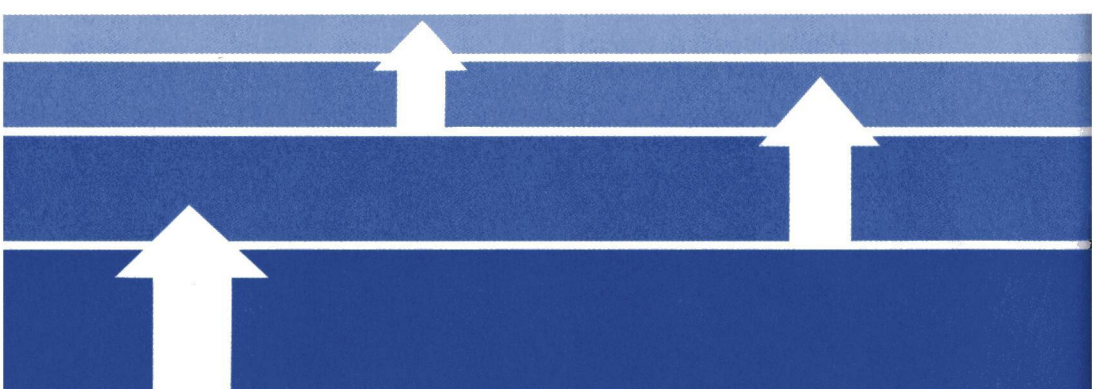
Federation of Master Builders
Gordon Fisher House
14/15 Great James Street
London WC1N 3DP

Federation of Master Builders
South-west Regional Office
83 Alma Road
Clifton
Bristol
Avon

Building Employers Confederation
82 New Cavendish Street
London WC1N 3DP

Building Employers Confederation
54, Longbrook Street
Exeter
Devon EH4 6AH

National House-Building Council
58 Portland Place
London W1N 4BU



**This booklet is for guidance only and is not a statement of the law.**

Prepared for the Department of the Environment by the Central Office of Information.
Printed in the UK for HMSO. September 1992. 12359 ENVI J080123NE 92 EPO 174.